Gamma-Ray Spectroscopy

Gamma-ray spectroscopy is a nondestructive technique used to identify and quantitate radioactive materials.

Principle of Technique

The sample is placed on a high-purity germanium detector and counted for up to 16 h. Two low-energy photon spectrometer (LEPS) detector gamma-ray solution counters are used. An integral computer is used to process the data. The energies of the peaks in the gamma-ray spectrum are characteristic of the radioactive isotopes present in the sample, and their intensities are proportional to the amounts of the radioactive isotopes present.

Samples

Form. Solid or liquid (at least 1 mg/mL concentration of plutonium).

Size. 0.5 to 1 g plutonium metal in 50 to 100 mL solution.

Preparation. Because counting is done outside glove boxes, samples must be doubly-contained in a polyethylene vial.

Limitations

Radioactive isotopes must emit gamma rays of suitable energy and intensity. One strongly radioactive isotope in a sample may mask the presence of others.

Estimated Analysis Time

Counting time varies from 2 to 16 h, but is usually 4 h.

Capabilities of Related Techniques

Wet chemistry, spectroscopy, XRF, and other similar techniques can identify the elements present but cannot provide isotope-specific information.

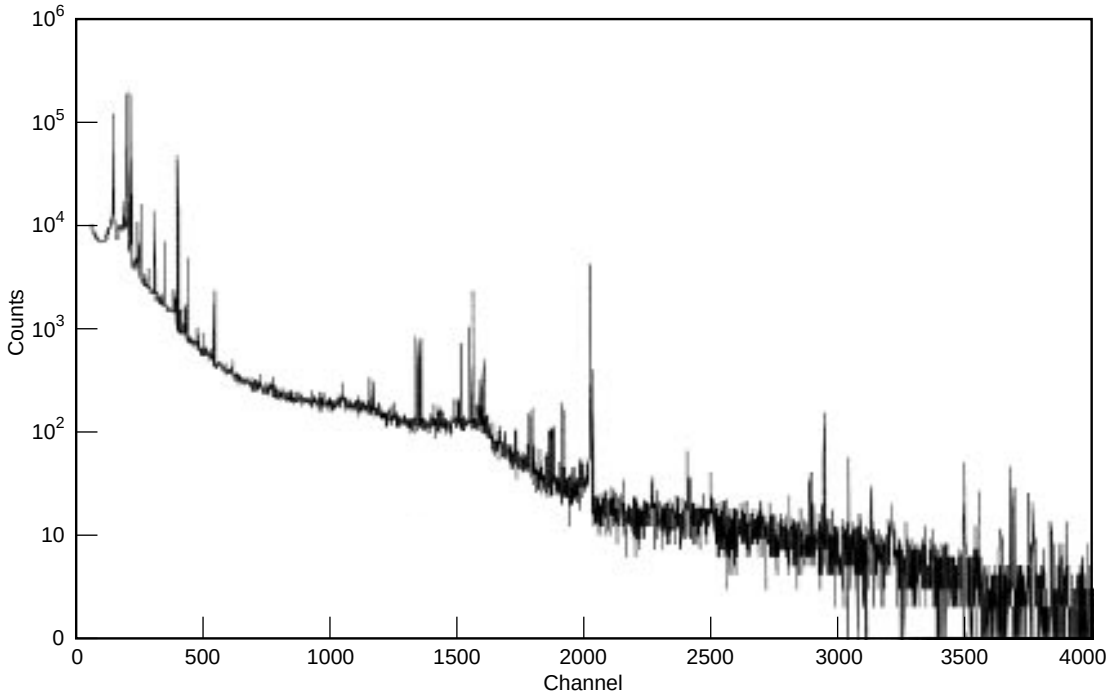
ICP-MS can identify specific isotopes and may be more sensitive than gamma-ray spectroscopy, but it is destructive and requires sample preparation.

Alpha counting and spectroscopy may provide complementary information.

Examples of Applications

- Analysis of weapons-grade and fuel-grade plutonium for ^{238}Pu, ^{239}Pu, ^{240}Pu, and ^{241}Pu.
- Determination of americium in plutonium.

Gamma-ray spectroscopy system.



Determination of plutonium in uranium tailings from Building 514 (counting time, 24 h).

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